

## **TAMPER RESISTANT VAPOR SENSOR METHOD AND SYSTEM**

### **TECHNICAL FIELD**

5           [001] Embodiments are generally related to sensing methods and systems. Embodiments are also related to residential and consumer appliances in general and fuel-fired heating appliances, such as, for example, gas-powered water heaters. Embodiments are also related to vapor sensors for detecting gas vapors.

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### **BACKGROUND OF THE INVENTION**

          [002] Gas-fired residential and commercial water heaters are generally formed to include a vertical cylindrical water storage tank with a gas burner disposed in a combustion chamber below the tank. The burner is  
15           supplied with fuel gas through a valved gas supply line, and combustion air through an air inlet flow path providing communication between the exterior of the water heater and the interior of the combustion chamber.

20           [003] Water heaters of this general type are extremely safe and quite reliable in operation. When gasoline or other flammable liquids are stored or used improperly in proximity to the water heater, however, it is possible that flammable vapors may become entrained in the air intake of the water heater. Such vapors might cause secondary combustion to occur within the  
25           confines of the water heater combustion chamber.

          [004] In residences where gas water heaters are located in close proximity to gasoline containers, there is a potential for the gasoline vapors to be ignited by an ignition device, such as, for example, the water heater  
30           pilot flame. A vapor sensor mounted to the water heater would shut down the pilot if gasoline vapors are detected. Present sensors capable of detecting flammable vapors can be rendered ineffective or deliver false

alarms when the sensing element is damaged, exposed to air flow, dust, liquids, oils, or other contaminants. The sensor may also be rendered ineffective if deliberately blocked so that vapors cannot reach the sense elements.

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[005] In view of the foregoing, a continuing need exists for the preclusion of fuel flow to the appliance when extraneous flammable vapors are present exteriorly adjacent the appliance. In particular, a continuing need exists for improved gas vapor sensors, which are resistant to

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contamination and also tampering.

## BRIEF SUMMARY OF THE INVENTION

[006] The following summary of the invention is provided to facilitate an understanding of some of the innovative features unique to the present invention and is not intended to be a full description. A full appreciation of the various aspects of the invention can be gained by taking the entire specification, claims, drawings, and abstract as a whole.

[007] It is, therefore, one aspect of the present invention to provide an improved sensor apparatus and method.

[008] It is another aspect of the present invention to provide for an improved gas vapor sensor.

[009] It is a further aspect of the present invention to provide for an improved gas vapor sensor, which is resistant to tampering and contamination from materials such as, for example, air flow, dust, liquids, and oils.

[0010] The aforementioned aspects of the invention and other objectives and advantages can now be achieved as described herein. A vapor sensor is disclosed, which includes a substrate containing a sensing element, wherein the substrate is located proximate to a sleeve portion which covers and protects the sensing element. The vapor sensor also includes a vapor filter affixed to an end of the sleeve portion, wherein the end of the sleeve portion is located opposite the sensing element. A housing and a cover are also provided, such that the housing retains the substrate and the cover snaps onto the housing. The housing itself includes walls from which a hole is formed through which vapors may pass.

[0011] The housing and the cover protect the vapor sensor apparatus from gravitationally settled materials thereof. Contoured surfaces are

generally formed from the housing and cover, which include one or more recessed areas that allow access to the hole by vapors. The hole is located centrally above sensing element. Additionally, the vapor filter can be formed of a fine mesh material. The sleeve portion also can be formed as a plastic sleeve attached to the substrate, while the cover and the housing can also be made from a plastic material. Plastic is, of course, an optional feature. Other types of materials may also be utilized in accordance with alternative embodiments.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The accompanying figures, in which like reference numerals  
5 refer to identical or functionally-similar elements throughout the separate  
views and which are incorporated in and form a part of the specification,  
further illustrate the present invention and, together with the detailed  
description of the invention, serve to explain the principles of the present  
invention.

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[0013] FIG. 1 illustrates an exploded view of a vapor sensor  
apparatus, which can be implemented in accordance with an embodiment of  
the present invention;

15 [0014] FIG. 2 illustrates a compacted view of the vapor sensor  
apparatus of FIG. 1, in accordance with an embodiment of the present  
invention;

[0015] FIG. 3 illustrates perspective views of the vapor sensor  
20 apparatus depicted in FIGS. 1-2 engaged with the walls of a water heater, in  
accordance with an embodiment of the present invention;

[0016] FIG. 4 illustrates alternative perspective views of the vapor  
sensor apparatus depicted in FIG. 1-3 engaged with the walls of a water  
25 heater, in accordance with an embodiment of the present invention; and

[0017] FIG. 5 illustrates a block diagram of a vapor sensing system, in  
accordance with an alternative embodiment of the present invention.

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## DETAILED DESCRIPTION OF THE INVENTION

[0018] The particular values and configurations discussed in these  
5 non-limiting examples can be varied and are cited merely to illustrate  
embodiments of the present invention and are not intended to limit the scope  
thereof.

[0019] FIG. 1 illustrates an exploded view of a vapor sensor apparatus  
10 100, which can be implemented in accordance with an embodiment of the  
present invention. FIG. 2, on the other hand, illustrates a compacted view of  
the sensor apparatus of FIG. 1, in accordance with an embodiment of the  
present invention. Note that in FIGS. 1 and 2, similar or identical parts are  
generally indicated by identical reference numerals. Vapor sensor apparatus  
15 100 generally includes at least two one-way snap posts 122 and 124, which  
can mount the sensor apparatus 100 to a wall of a water heater, thereby  
providing protection to the sensor surface from physical impact.

[0020] Vapor sensor apparatus 100 generally includes a contoured  
20 surface 109 of a cover 110 for a housing 102. The contoured surface 109  
permits the vapor sensor apparatus to be mounted in close proximity to a  
water heater. Recessed areas on such a contoured surface allows access of  
vapors to a hole 140 that is formed from circular internal walls 141 of the  
cover 110. The hole 140 is located generally within the center of cover 110  
25 directly over a sensing element 107, which is protected by a sleeve portion  
106 for maintaining and protecting sensing element 107.

[0021] Although sensing element 107 is shown in FIG. 1 as having a  
square shape, it can be appreciated that the shape of sensing element 107  
30 can also be circular or rectangular as can the shape of sleeve portion 106.  
The recesses (e.g., hole 150) can be sized so as not to allow foreign  
materials to enter the access hole 140. Hole 140, can for example, be

angled downward so as to allow foreign particles and fluids to move away from hole 140 and prevent gravitation settling of dust or liquids.

[0022] Vapor sensor apparatus 100 can be designed to accept a  
5 connector with a latching feature as shown in 118 and its mating surface in the housing 102. . The keying of the connector can result in the latching feature to also be within close proximity to a wall of the water heater, which may require a tool to disengage the connector. The sleeve portion 106 which surrounds and protects the sensing element 107 can comprise a filter,  
10 permeable membrane or fine mesh screen, which passes vapors, but protects the internal components of vapor sensor apparatus 100 from dust and liquids. Housing 114 generally includes a tabular or snap portion which can connect to a receiving portion 112 of cover 110. Vapor sensor apparatus 100 also includes leads 130, 132, 134, and 136, which are  
15 connected to substrate 104. Leads 130, 132, 134 and 136 respectively connect to leads 202, 204, 206, and 208 through a lead portion 120, a portion 118 of which is maintained by housing 102 and cover 110.

[0023] In general, a substrate 104 contains sensing element 107,  
20 which is protected by sleeve portion 106. Note that sleeve portion 106 can be configured as a plastic sleeve. Plastic is, of course, an optional feature. Other types of materials may also be utilized in accordance with alternative embodiments. The sleeve portion 106 or plastic sleeve is generally attached to substrate 104 to cover and protect sensing element 107. A filter 108 is  
25 generally affixed to the end of the sleeve portion 106 that is opposite substrate 104. Filter 108 can be formed from a fine mesh material that passes vapors (e.g., gas vapors), but does not allow foreign materials to enter and/or come into contact with sensing element 107.

30 [0024] A substrate assembly, which includes substrate 104 and leads 130, 132, 134, and 136 can be located and assembled within housing 102 to retain the substrate 104. Housing 102 can be formed from a plastic material,

as can cover 110. Again, plastic is an optional feature. Other types of materials may also be utilized in accordance with alternative embodiments. The design of the cover 110 and housing 102 generally allows the connector 118 to be keyed for insertion and ensure that the vapor sensor apparatus 100 is protected from gravitationally settled dust or liquids. The vapor sensor apparatus 100 can then be mounted into a water heater and an electrical connection made.

[0025] FIG. 3 illustrates perspective views of the vapor sensor 100 apparatus depicted in FIGS. 1-2 engaged with a wall 302 of a water heater, in accordance with an embodiment of the present invention. FIG. 4 illustrates alternative perspective views of the vapor sensor apparatus 100 depicted in FIG. 1-3 engaged with wall 302. Note that in FIGS. 1-5, similar or identical parts are indicated by identical reference numerals. Thus, vapor sensor apparatus 100 is shown in both FIGS. 3 and 4 with the cover 110 in contact with wall 302 of the water heater.

[0026] FIG. 5 illustrates a block diagram of a vapor sensing system 500, in accordance with an alternative embodiment of the present invention. Vapor sensor apparatus 100 can communicate with a microprocessor 502 and a controller 504 to form a vapor sensing system 500 that can be utilized to automatically shut off water heater 506 in the event that gas vapors are detected by vapor sensor apparatus 100. The vapor sensor apparatus (e.g., a gas vapor sensor) can be mounted to the water 506 as explained previously.

[0027] As indicated in FIGS. 3 and 4 above, the vapor sensor apparatus 100 is mounted to a water heater (e.g., wall 302 of a water heater 506) in a manner which reduces air flow to the sensing element 107 and which also prevents or limits tampering of vapor sensor apparatus 100, because the cover 110 of the vapor sensor apparatus 100 faces the wall 302 of water heater 506. Alternatively, the sensor may be mounted on the

concave or convex surface of the casing (i.e., walls of the water heater 506). The apparatus described herein will also function properly if mounted on a flat surface. The vapor sensor apparatus 100 can thus automatically shut off, via microprocessor 502 and controller 504, a pilot flame (i.e. a "pilot") or  
5 other ignition device associated with the water heater 506 if gas vapors are detected.

[0028] Note that microprocessor 502 can be implemented as central processing unit (CPU) of a computer or other data-processing machines.  
10 Examples of microprocessor chips which can be utilized in accordance with embodiments include microprocessors such as the "Pentium" line of microprocessor from Intel Corporation, the PowerPC chip, and so forth. Of course, it can be appreciated that these chips are only presented for illustrative and exemplary purposes and do not represent limiting features of  
15 the present invention. Microprocessor 502 generally functions to process and manipulate data. For example, microprocessor 502 performs processing functions, which is generally a vital procedure between receiving data (i.e., input) and producing results (e.g., output). Controller 504, on the other hand, generally performs an arbitrating or regulating function and is  
20 utilized to control "on" and "off" functions associated with water heater 506.

[0029] The embodiments and examples set forth herein are presented to best explain the present invention and its practical application and to thereby enable those skilled in the art to make and utilize the invention.  
25 Those skilled in the art, however, will recognize that the foregoing description and examples have been presented for the purpose of illustration and example only. Other variations and modifications of the present invention will be apparent to those of skill in the art, and it is the intent of the appended claims that such variations and modifications be covered.

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[0030] The description as set forth is not intended to be exhaustive or to limit the scope of the invention. Many modifications and variations are

possible in light of the above teaching without departing from the scope of the following claims. It is contemplated that the use of the present invention can involve components having different characteristics. It is intended that the scope of the present invention be defined by the claims appended hereto,

5 giving full cognizance to equivalents in all respects.